IN THE CLAIMS

Please amend the claims as follows.

1. (Currently Amended) A complete bandgap 3D photonic crystal, comprising:

a first periodic array of unit cells formed in a substrate from first voids connected by imaginary bonds, wherein the first voids are distinct from each other, and wherein the first periodic array alone forms an incomplete bandgap; and

a second periodic array of second voids, wherein the second voids are distinct from each other and from the first voids, wherein each second void is arranged along one of the imaginary bonds so as to modify each unit cell to form a complete photonic bandgap.

2. (Original) The photonic crystal of claim 1, wherein the unit cell is a diamond unit cell.

3. (Original) The photonic crystal of claim 1, wherein the first voids are spherical.

4. (Original) The photonic crystal of claim 3, wherein the second voids are spherical.

5. (Original) The photonic crystal of claim 4, wherein the first and second voids are substantially the same size.

6. (Original) The photonic crystal of claim 1, wherein a single second void is arranged halfway between the first voids in the unit cell.

7. (Original) The photonic crystal of claim 1, wherein two or more of the second spherical voids lie along each imaginary bond.

8. (Original) The photonic crystal of claim 1, wherein the substrate includes a material selected from the group of materials consisting of a linear optical material, a non-linear optical material, a metal, a semiconductor, an insulator, a dielectric, an acoustic material, a magnetic material, a ferroelectric material, a piezoelectric material, and a superconducting material.

9. (Currently Amended) A complete bandgap 3D photonic crystal, comprising:

a first periodic array of diamond unit cells formed in a substrate from first voids connected by imaginary bonds, <u>wherein the first voids are distinct from each other, and</u> wherein the first periodic array forms an incomplete bandgap; and

a second periodic array of second voids<u>, wherein the second voids are distinct from each other and from the first voids, and</u> wherein each second void is arranged along one of the imaginary bonds so as to modify each diamond unit cell to form a complete photonic bandgap.

10. (Original) The photonic crystal of claim 9, wherein the first voids are spherical.

11. (Original) The photonic crystal of claim 10, wherein the second voids are spherical.

12. (Original) The photonic crystal of claim 11, wherein the first and second voids are substantially the same size.

13. (Original) The photonic crystal of claim 9, wherein a single second void is arranged halfway between the first voids in the unit cell.

14. (Original) The photonic crystal of claim 9, wherein two or more of the second voids are arranged along each imaginary bond.

15. (Original) The photonic crystal of claim 9, wherein the substrate includes a material selected from the group of materials consisting of a linear optical material, a non-linear optical material, a metal, a semiconductor, an insulator, a dielectric, an acoustic material, a magnetic material, a ferroelectric material, a piezoelectric material, and a superconducting material.

16. (Currently Amended) A complete bandgap 3D photonic crystal comprising:

a periodic array of unit cells formed in a substrate, wherein each unit cell consists of a plurality of first voids joined by imaginary bonds, <u>wherein the first voids are distinct from each other, and</u> wherein the periodic array forms an incomplete bandgap; and

one or more second voids formed along respective one or more of the imaginary bonds so as to modify each unit cell to create the complete photonic bandgap<u>, wherein the second voids are distinct from each other and from the first voids</u>.

17. (Original) The photonic crystal of claim 16, wherein the first periodic array of voids has an associated filling ratio, and the one or more second voids are sized to substantially increase the filling ratio.

18. (Original) The photonic crystal of claim 16, wherein at least one of the first and second voids are spherical.

19. (Original) The photonic crystal of claim 16, wherein the unit cells are diamond unit cells.

20. (Original) The photonic crystal of claim 16, wherein a single second void is arranged halfway between the first voids in the unit cell.

21. (Original) The photonic crystal of claim 16, wherein two or more of the second voids are arranged along each imaginary bond.

22. (Original) The photonic crystal of claim 16, wherein the substrate includes a material selected from the group of materials consisting of a linear optical material, a non-linear optical material, a metal, a semiconductor, an insulator, a dielectric, an acoustic material, a magnetic material, a ferroelectric material, a piezoelectric material, and a superconducting material.

23. (Currently Amended) A three-dimensional photonic crystal, comprising:

a periodic array of diamond unit cells each consisting of a plurality of first voids formed in a substrate with a refractive index, the first voids connected by imaginary tetrahedral bonds, wherein the first voids are distinct from each other;

a plurality of second voids, with at least one second void formed along one of the imaginary tetrahedral bonds, wherein the second voids are distinct from each other and from the first voids; and

wherein the plurality of first voids has an associated filling ratio that in combination with the substrate refractive index results in an incomplete bandgap, and wherein and the second plurality of voids increases the filling ratio so as to form a complete bandgap.

24. (Original) The photonic crystal of claim 23, wherein the first and second voids are formed in the substrate by surface transformation.

25. (Original) The photonic crystal of claim 23, wherein the first and second voids are spherical voids.

26. (Original) The photonic crystal of claim 23, wherein the complete bandgap has a wavelength that includes one of x-ray, ultraviolet, visible, infrared and microwave.

27. (Original) The photonic crystal of claim 23, wherein the complete bandgap includes phonon wavelengths.

28. (Original) The photonic crystal of claim 23, wherein a single second void is arranged halfway between each of the first voids in each diamond unit cell.

29. (Original) A three-dimensional photonic crystal product formed by the process of:

forming a plurality of first voids in a substrate, including arranging the first voids in a period array of unit cells with imaginary bonds connecting the first voids in the unit cell, such that the period array has an incomplete bandgap; and

forming a plurality of second voids in the substrate along at least one of the imaginary bonds in each unit cell so as to form a complete bandgap.

30. (Original) The photonic crystal product of claim 29, wherein the process includes forming the pluralities of first and second voids by surface transformation.

31. (Original) The photonic crystal product of claim 29, wherein the process includes forming the unit cells as diamond unit cells.

32. (Original) The photonic crystal product of claim 29, wherein the process includes forming at least one of the first and second voids as spherical voids.

33. (Original) The photonic crystal product of claim 29, wherein the process includes selecting a substrate that includes a material selected from the group of materials consisting of a linear optical material, a non-linear optical material, a metal, a semiconductor, an insulator, a dielectric, an acoustic material, a magnetic material, a ferroelectric material, a piezoelectric material, and a superconducting material.

34. (Original) The photonic crystal product of claim 29, wherein the periodic array of first voids has an associated filling ratio, and wherein the process includes forming the second voids in the substrate to substantially increases the filling ratio.

35. (Original) The photonic crystal product of claim 34, wherein the process includes calculating a gap/mid-gap ratio as a function of the filling ratio, and forming the second voids to achieve a desired gap/mid-gap ratio.

36. (Original) The photonic crystal product of claim 34, wherein the process includes empirically determining a gap/mid-gap ratio as a function of the filling ratio, and forming the second voids to achieve a desired gap/mid-gap ratio.

37. (Original) The photonic crystal product of claim 29, wherein the process is carried out in the order presented.

38. (Original) A three-dimensional complete bandgap photonic crystal product formed by the process comprising:

providing a substrate having a refractive index of 2 or greater for a select wavelength;

forming in the substrate a first periodic array of first voids from unit cells connected by imaginary bonds, wherein the first periodic array has an incomplete bandgap for the select wavelength; and

forming a second periodic array of second voids, wherein the second voids are arranged at least one each along each of the imaginary bonds so as to form the complete bandgap at the select wavelength.

39. (Original) The photonic crystal product of claim 38, wherein the process includes forming the first and second voids by surface transformation.

40. (Original) The photonic crystal product of claim 39, wherein the process includes forming the first voids to be spherical.

41. (Original) The photonic crystal product of claim 40, wherein the process includes forming the second voids to be spherical.

42. (Original) The photonic crystal product of claim 41, wherein the process includes forming the unit cells of the first periodic array to be diamond unit cells.

43. (Original) A method of forming a three-dimensional complete bandgap photonic crystal, comprising:

forming a periodic array of unit cells in a substrate, wherein each unit cell consists of a plurality of first voids joined by imaginary bonds, and wherein the periodic array forms an incomplete bandgap; and

forming one or more second voids along respective one or more of the imaginary bonds in each unit cell so as to modify the periodic array to create the complete photonic bandgap.

44. (Original) The method of claim 43, wherein the method includes forming the first and second voids by surface transformation.

45. (Original) The method of claim 43, wherein the method includes forming the unit cell as a diamond unit cell.

46. (Original) The method of claim 43, wherein the method includes forming the first voids as spherical voids.

47. (Original) The method of claim 46, wherein the method includes forming the second voids as spherical voids.

48. (Original) The method of claim 47, wherein the method includes forming the first and second voids to be substantially the same size.

49. (Original) The method of claim 43, wherein the method includes forming the second spherical voids such that two or more second spherical voids lie along each imaginary bond.

50. (Original) The method of claim 43, wherein the method includes providing a substrate made of a material selected from the group of materials consisting of a linear optical material, a non-linear optical material, a metal, a semiconductor, an insulator, a dielectric, an acoustic material, a magnetic material, a ferroelectric material, a piezoelectric material, and a superconducting material.

51. (Original) The method of claim 43, wherein the method includes forming a single one of the second voids halfway between each of the first voids in the unit cell.